THE UNIVERSITY OF ALBERTA

STIMULUS RECODING IN PAIRED-ASSOCIATE TRANSFER WITH HIGH-MEANINGFUL STIMULI

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1972

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled STIMULUS RECODING IN PAIRED-ASSOCIATE TRANSFER WITH HIGH-MEANINGFUL STIMULI submitted by DONA R. CARLSON in partial fulfilment of the requirement for the degree of Master of Science.

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Abstract

On the basis of Martin's (1968) analysis of the effects of stimulus encoding variability on paired-associate transfer it was hypothesized that a mitigation of the effects of response re-pairing (A-B, A-Br) might be obtained, wherein the stimulus (A) terms were words of multiple semantic interpretations, and therefore potentially recodeable. In Experiments I and II subjects were provided with stimulus encoding cues such that they might be expected to utilize either the same or different encodings of the A terms in A-B and A-Br learning. Neither experiment provided clear support for the hypothesis. Experiment III employed Animal-Furniture compounds as stimulus (A) terms. A clear facilitation was obtained when subjects were required to use different components in A-B and A-Br learning. The results were discussed in light of increasing experimental evidence that the provision of stimulus-recoding opportunities does not, in general, reduce interference as indexed by transfer performance.

Acknowledgements

I wish to thank my advisor, Dr. A. R. Dobbs for his assistance during the writing of this thesis.

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Introduction

It is a well known phenomenon of paired-associate learning that associating a new or different response to an old stimulus is difficult. One explanation for this has been that in order for the second association to be formed, the incompatible first association must be extinguished or unlearned (Melton and Irwin, 1940; McGovern, 1964). In accordance with this interpretation second list learning when the stimulus (A) terms remain unchanged, and the response terms are re-paired (A-B, A-Br) or replaced (A-B, A-D) requires that the original association (A-B) be unlearned. If new stimuli are used in the transfer list this unlearning is not necessary, so that for control paradigms, in which new stimulus terms are employed such as A-B, C-B and A-B, C-D, second-list learning is relatively easy.

Martin (1968) has utilized Underwood's (1963) distinction between functional and nominal stimuli in a reanalysis of transfer in paired-associate learning. This distinction, which Underwood applied to the learning of a single list, involved recognition of the possibility that the stimulus presented by the experimenter (nominal stimulus) and the stimulus used by the subject (functional stimulus) need not be isomorphic.

Essentially Martin suggested that transfer paradigms (for example, an A-B, A-D paradigm) should be viewed in terms of the functional or subject-encoded stimulus. If the subject encodes the stimulus term identically on both lists, then with respect to the

functional stimulus (as well as the nominal stimulus) the paradigm is one that will produce interference. Should the subject encode the stimulus differently on the second list, the nominal A-B, A-D paradigm will be functionally an A-B, C-B paradigm. Under certain conditions one would expect that interference paradigms should not produce as inferior a performance (with respect to the appropriate control conditions) as is generally found with these paradigms. These conditions are obviously those which maximize the likelihood that a subject will encode the stimuli differentially on the two lists.

As evidence for this position Martin presents an experiment in which subjects learned lists conforming to either an A-B, A-Br or an A-B, C-B paradigm. For half of the subjects the stimuli were high-meaningful words and for the others, low-meaningful CVC's. Since Martin's analysis of the results of this study was the impetus for the present research, his interpretations will be considered in detail.

Martin first assumed that in paired-associate learning, stimuli which differ in meaningfulness differ also in the number of available encodings. Stimuli of high meaningfulness are assumed to be encoded only in one manner, as whole pronounced units. When meaningfulness is low, on the other hand, stimuli may be encoded in terms of some fraction of the presented letters, or some elaboration thereof, or merely as a sequence of letters. Thus, if a subject was presented with the word CAT as a stimulus it was assumed that he would repeatedly encode the stimulus as the pronounced unit "CAT". Contrarily if a trigram of low meaningfulness, such as CIR is presented, it was

assumed that it might be differentially encoded on different trials. It might be encoded as C-I-R or perhaps as "C" or "R". Stimuli of low meaningfulness, therefore, were seen as being encodable in a number of different ways. This differential encoding on various trials Martin called encoding variability.

Martin argued that the effect of this encoding variability can be seen both in original and trasnfer learning. It is commonly observed that learning to associate an arbitrary response to a stimulus term is more difficult when the stimuli are low in meaningfulness. Underwood and Schulz (1960) have presented an associative probability explanation for this effect of stimulus meaningfulness in paired-associate learning. Their argument was that highly meaningful stimuli have more associates so that the probability of finding an association to mediate the link between the stimulus and the response is increased. Martin, however argued that the difference between stimuli of high and low meaningfulness lay in the difficulty of obtaining a consistent encoding for the low-meaningful stimuli. Until a subject learned to encode a stimulus in a consistent manner over successive trials he would find it exceedingly difficult to learn to give the correct response invariably to that item. Martin suggested that once a subject had a stable encoding, the association was learned rotely.

In the transfer situation wherein the responses are re-paired (A-B, A-Br) Martin suggested that with meaningful word stimuli which had no encoding variability, the subject must encode the word in the same manner on the second list. In order to learn an association to

such a word it would be necessary to unlearn or extinguish the original association. Thus for meaningful stimuli McGovern's analysis was appropriate. With less meaningful stimuli Martin postulated that upon presentation of the second list the subject again sampled the possible stimulus encodings. If he sampled the encoding used on the first list he would find that this lead to interference. This choice of encoding would therefore not be reinforced. Ultimately the subject would settle on a new encoding which would be different from that used in the first list. In this case the paradigm, with respect to the functional stimuli, in the event of response re-pairing was not A-Br but rather C-B. For stimuli of low meaningfulness, the difference between the A-Br and C-B paradigms would be less for such stimuli, compared to the difference between the same paradigms for high meaningful stimuli.

On the basis of this analysis Martin predicted that first-list learning should show a superiority for the more meaningful stimuli, and that the difference between the A-Br and C-B paradigms would be less for the less meaningful stimuli. Martin's results were confirmative of this expectation. Table 1 shows the mean trials to criterion for the first- and second-list learning for the four conditions of this experiment (Martin, 1968).

In brief, Martin argued that high- and low-meaningful stimuli differed along a dimension of encoding variability, and that it was this difference which accounted for the superior performance in A-B learning with high-meaningful stimuli and for the relatively

Table 1

Mean Trials to Criterion on First and Transfer List

(from Martin, 1968)

	Meaningfulness	
Paradigm	High	Low
A-Br	11.90 (12.10)	11.90 (16.30)
C-B	7.95 (13.70)	9.95 (15.55)

Note. Mean trials to criterion for List I (A-B) are shown in parentheses.

(compared to a C-B control) better performance in A-Br transfer with low meaningful stimuli. While Martin's assumption of an inverse correlation between stimulus meaningfulness and stimulus encoding variability has a certain intuitive appeal, it does seem clear that a more rigorous investigation of the stimulus recoding hypothesis demands the experimental manipulation of stimulus recodability. Perhaps if one were to use stimuli which were potentially recodeable for all subjects and manipulate the likelihood that a subject would use some particular encoding, one might be able to obtain evidence for a stimulus recoding position in terms of differences in performance on a common final list. One would have strong evidence for the Martin position if interference was reduced when the experimental situation was such that a subject learning the first list would use one stimulus encoding and on the second list an alternate encoding of the same nominal stimulus. One could then compare directly two interference conditions with identical stimuli, which differed only in the recoding of the stimulus terms.

If one accepts the contention that high- and low-meaningful stimuli generally differ in encoding variability, it also seems possible that at the semantic level high-meaningful stimuli might also exhibit encoding variability. Certainly many words in the English language can be taken to have different meanings or referents. Might not these be considered encodings? The word "ruler" for example, may on one occasion be taken to mean "a measuring device" while on another occasion it may be taken to mean "monarch". Yet in normal usage we

have little difficulty in determining which meaning is to be used in a particular situation. However, in normal usage a context is provided which determines the appropriate encoding. Thus unless one is speaking of Lilliputians, the term "a twelve inch ruler" gives one no difficulty in assertaining which encoding or meaning is to be used. If a word such as ruler were used as the stimulus or A term in an A-Br paradigm and if a subject could encode the word according to one semantic interpretation on one list and then recode that same word on the second list, so that the other interpretation was used, one would expect to find a mitigation of the adverse effects of re-pairing the response terms.

There is, however, a serious problem with this. Consider the situation in the following manner. Suppose a subject on List I encoded "ruler" as a measuring device. When he was presented with that word on List II he must, in order to avoid interference have learned not to respond to that word as "measuring device" and have learned to respond to it as "monarch". Plainly he must have learned to inhibit one response (albeit an implicit one) and then to have learned a new response to that stimulus. Since, in fact, the only cue as to the appropriate encoding for List II was that it is the encoding not used on List I it would appear that this situation might have produced even more interference than the more conventional A-D paradigm as it was not possible to unlearn the old encoding response and still use it as a cue for the determining of the new encoding response. Thus it would appear that one can reject the concept of recoding as a means of

reducing the effect of interference for high-meaningful stimuli in such situations. There is however a possibility that one might obtain stimulus recoding with meaningful stimuli under certain conditions, if the subject could be told which encoding was appropriate for each item in a particular list. This would eliminate the problem discussed above. However, telling the subject which encoding to use for a particular stimulus would seem to present some difficulty. A consideration of the situation for low-meaningful stimuli might provide a solution to this problem.

It should be noted that a similar criticism of stimulus recoding as conforming to an interference paradigm with respect to the encoding response and the presented stimulus could be made for the low-meaningful situation. However, for low-meaningful stimuli it would appear that one might eliminate the problem of selecting an appropriate encoding by the invocation of rules. A rule, as suggested by Richardson (1971), is that which permits differentiation of one encoding from another for each item in a paired-associate list without differentiating between items in the list. With low-meaningful items, a subject might for example, use the rule "select the first letter". Such a rule could be applied to any item in the list and if all items began with different letters it would result in encodings as discriminative and informative as the original item. Recoding in this instance would involve merely a change in rules so that stimuli would be encoded according to different rules on the original and the transfer list. For example, if in an A-B, A-Br paradigm a subject selected

the first letter of each item for the first list, and the third letter for the second list, then functionally the paradigm would be A-B, C-B.

With meaningful stimuli such rules generally are not available (that is, rules which determine particular semantic encodings for each stimulus; it is assumed that subjects do not select letters when the stimuli are meaningful). If one could provide such rules for meaningful stimuli then it seems clear that one would also be able to obtain recoding in this case.

The studies that are to be reported here arose out of the above considerations. Specifically the aim of this research was to demonstrate a facilitation in an A-Br transfer paradigm as a result of stimulus recoding with meaningful stimuli. It was also intended that the present studies should also allow one to compare performance on a common final list for recoding and nonrecoding conditions, thus avoiding the methodological difficulty of the Martin study.

In order to produce encoding and recoding of the high-meaningful stimuli in a predetermined manner, two procedures were used. In Experiments I and II the encoding of the words was manipulated by the use of words which could be used as nouns and as verbs. The word "hide" for example, can be interpreted as a noun (an animal skin) or a verb (to conceal). If the subject could be lead to use the noun form on one list and the verb form on the other, then according to the foregoing analysis one would expect the effect of response repairing to be mitigated in terms of a superior performance over a

subject using the same encoding in both lists. Note that encoding rules were then possible as one could say, "select the noun form for each stimulus". This would not tell you what the semantic interpretation would be, but it would distinguish between two semantic encodings of the item. This would be particularly true if one selected the stimuli so that the noun and verb forms of the words were maximally distinct, as is the case with "hide" above. In Experiment I the subjects were given, essentially, a hint as to the appropriate encodings of the stimulus terms, that is the encodings that would eliminate interference. In Experiment II the encoding possibilities were made more obvious. In Experiment III stimulus encoding was manipulated by the use of compound stimuli consisting of two words, each from a different category. Since within the list only two categories were used the subject could be instructed to select the word from the compound which was a member of a given category and associate it to the given response. Recoding then involved changing the relevant category from List I to List II.

Experiment I

The aim of this experiment was to demonstrate a decrease in interference in an A-B, A-Br transfer paradigm due to the recoding of the stimuli in the A-Br list. The recodeable items were high-meaningful words which by local concensus were considered to be commonly interpretable as either nouns or verbs. In the experimental condition it was intended that the subjects would use different interpretations of the recodeable items for A-B and A-Br learning. Thus if the recodeable items were encoded as nouns for the first list they would be encoded as verbs for the second list. However in the control condition it was intended that the same encoding be used for both lists.

In order to obtain control of the encoding of the recodeable items a set was established for interpreting these items as either all nouns or as all verbs. This set was established by presenting six other words, interpretable as only nouns or as only verbs, so that the subject learned a twelve item paired-associate list. These other words are referred to as context items so as to distinguish them from the recodeable items described above.

It was presumed that when the context items were presented in the same paired-associate list as the recodeable items the subject would be primed to encode the recodeable items and the context items similarly. If the context items differed in terms of part of speech for the A-B and A-Br list then it was also presumed that this would

lead the subject to encode the stimulus items first in one manner then in the other. Thus, since different functional stimuli would be used for the A-B and A-Br lists interference would be reduced.

It should be noted that the recodeable items were presented so as to conform to an A-B, A-Br paradigm while the context items were to conform to an A-B, C-B paradigm. This was necessary since changing the part of speech of the context items demands that the items themselves be replaced. In the control condition where the part of speech was not to be changed, different context items were used in the two lists. They were however, always nouns or verbs. This A-B, C-B paradigm should not however be interpreted as a control condition for determining the amount of interference produced by the re-pairing of the responses to the recodeable items. Since the recodeable and context items were specifically selected to differ in respect to their recodability such a comparison is not justified. This lack of an appropriate control for determining the amount of interference produced by the response re-pairing is not a problem in as much as the comparison of interest is between two A-Br conditions.

Method

Design and lists. The two major conditions of this experiment were the Experimental condition in which the stimuli in a paired-associate transfer task (A-B, A-Br) were to be recoded and the Control condition in which the stimuli were not to be recoded. In addition the design also included as factors the part of speech of the context items and (within subjects) the type of stimulus item (recodeable versus context) so that the design of the experiment was basically a 2 x 2 x 2 factorial design with one repeated measure.

For all subjects the A-B list consisted of 12 word-number pairs. Six of the A terms were recodeable and six were context items. The B terms were the numbers 1 to 12 and were paired with the words in a random manner. The transfer list consisted of the same six recodeable items with their responses re-paired and the six new context items paired with the numbers previously paired with the context items of the first list. In the Experimental condition these context items were of the opposite part of speech from that used in the first list. In the Control condition the part of speech was not changed.

For purposes of generality two different recodeable item sets were used. Associated with each of these were two sets of context items - one noun set and one verb set. There were thus, four lists which differed in their context items. It should be noted that this arrangement of lists confounds the interactions of type of stimulus item (Recodeable versus Context), part of speech, and recodeable item set with item differences. These four lists served equally often for

the Experimental and Control conditions in transfer. The first list for the two conditions however did differ as the design was not counterbalanced with respect to the order in which the lists were used. All lists used in this experiment are given in Appendix A.

Procedure. Both lists were presented at a 2-second rate on a Stowe Memory Drum. No instructions as to the nature of the stimulus terms were given, but in order to set the initial encoding for each list the context items were presented first. Three separate orders of presentation were used for the study and test trials to prevent serial learning. The instructions to the subjects for this experiment are given in Appendix B. The first list was learned to a criterion of one-perfect test trial. The second list was then presented for 10 study-test cycles.

Subjects. The subjects for this experiment were 32 introductory psychology students from the University of Alberta volunteering as an option for course credit. The numbers of males and females were equal in all conditions. Subjects were assigned to conditions, as they appeared for the experiment, in accordance with a predetermined random schedule.

Results

List I. For each subject the trials to criterion were computed separately for the context and recodeable items. Significantly more trials were required to learn the recodeable items, $F(1,16) = 11.08$, $p < .01$, than the context items. The magnitude of the difference however depended upon the stimulus set used. The interaction of type of item (Context and Recodeable) and stimulus set approached significance, $F(1,16) = 4.14$, $p < .10$. No other effect approached significance.

List II. The mean total correct over 10 trials for the recodeable items for the Experimental and Control conditions were 37.12 and 38.56 respectively. This difference is not as predicted. The analysis of variance revealed that neither the comparison between the Experimental and Control conditions nor the interaction of this variable with type of stimulus item (Context versus Recodeable) were significant, F's < 1.

The difference between the recodeable and context items found in List I was also present in List II, $F(1,16) = 104.43$, $p < .001$. Since the context and recodeable items also conform to C-B and A-Br paradigms respectively, one may attribute the difference obtained here to a probable combination of the effects of an item difference and the paradigm manipulation.

Experiment II

The failure to find even slight evidence for a facilitation in transfer due to stimulus recoding in the previous experiment suggests several possibilities. It may be that the context cues provided were too subtle, so that subjects did not consistently encode the stimuli in the desired manner. If the encoding cues did not successfully prime the selection of the experimenter-designated encodings for the recodeable items it would seem possible that the subject may have had difficulty in determining a consistent encoding for each of these items. If the subject used the noun interpretation on one trial and the verb interpretation on another one might well expect his performance to be adversely affected. This interpretation is supported by the observation that the recodeable items were the more difficult to learn in List I. The results of the first list performance would therefore suggest that Martin's concept of stimulus encoding variability might also be applied to high-meaningful stimuli when these stimuli have several possible semantic encodings.

Another possibility is that while the subjects were able to recode the stimuli, the resultant codes may not have been semantically distinctive enough from the original encodings to be functionally different. Finally it is possible that recoding is an inherently difficult procedure such that subjects are unable or unwilling to encode the same stimulus differently on two lists.

The purpose of Experiment II was to investigate some of these possibilities and to correct some of the deficiencies of the previous

study. Specifically the intent of this experiment was to make the encoding-recoding cues more potent by priming the subjects to attend to the experimenter-designated encoding. The encoding of the stimulus terms was manipulated by presenting each item preceded by the word "I" or "THE" so that the words might be encoded as verbs or nouns, respectively. To ensure that the subjects attended to the preceding word, that is, "I" or "THE" they were required to read the stimulus phrase aloud on study trials. In addition to investigate the effect of variations in encoding similarity the semantic differences between the two possible encodings of the stimulus were maximal for one condition and minimal for another. In the condition of maximal discrimination between encodings the terms were in fact homonyms, such as "wave" in "I wave my hand" and "That is a wave on the ocean".

This study also employed independent C-B groups so that differences between paradigms for conditions of high and low recodeability of the stimulus terms could be obtained. This then allows one to study the recoding of the stimulus terms independently of the effects of associative interference. In addition to the transfer data, A-B recall data was also obtained.

Method

Design and lists. This experiment employed a 2 x 2 x 2 factorial design varying the transfer paradigm (A-Br, C-B), stimulus recodeability (High versus Low), and the semantic similarity of the stimulus encodings (Congruent, for example, "grease" versus Noncongruent, for example, "hide"). The stimulus terms were words, like those used in Experiment I, which could be encoded as nouns or verbs. The cue for selecting the appropriate encoding was provided by preceding the word with either "I" or "THE" so as to bias an encoding as either a verb or a noun, respectively. All words within a list were preceded by the same prefix. Since on the basis of pilot work it had been found that subjects tend to ignore such redundancy, the subjects were required to study the stimulus and response aloud. In the condition wherein the stimuli were to be recoded, the prefix presented on the first and second lists differed. If the word was encoded as a noun on one list it could be encoded as a verb on the other. Verb and noun encoding cues were used equally often for both first and second lists.

Two sets of stimulus items were used - congruent and noncongruent. It should be noted that in the C-B condition the subjects saw both sets of stimuli. While it would probably have been preferable to have two sets of congruent and noncongruent stimuli this was not possible as the noncongruent stimuli were relatively rare. Since this experiment was concerned both with transfer performance and A-B recall the presentation of lists was counterbalanced so that comparisons could be made between conditions over identical lists. The B terms were the digits 2 to 9.

Procedure. All lists were learned by a study-test procedure on a Stowe Memory Drum at a 2-second rate. Lists I and II were learned to criterions of one- and two-perfect-test trials, respectively. Prior to learning the second list, the subjects were presented with the stimulus terms for that list by presenting an unpaced test trial and asked to define each word and then to use it in a sentence. It was hoped that this would further draw the subjects' attention to the recoding possibility. Once the subject had seen all the stimulus terms the memory drum was advanced to a study trial.

After List II had been learned the List I tape was placed on the memory drum, and an unpaced test trial was given. This was followed by sufficient study-test trials to relearn the list to the original criterion of one perfect test trial.

The lists used in this experiment and the instructions to subjects are given in Appendices A and B respectively.

Subjects. Sixty-four subjects served to replicate the complete design twice. The subjects were drawn from the same source as used in Experiment I, however a year intervened between the two experiments. Equal number of males and females served in all conditions.

Results

All lists were analyzed as 2 x 2 x 2 x 2 x 2 factorial designs with factors of paradigm (A-Br versus C-B), recodeability (High versus Low), semantic similarity of codes (Congruent versus Noncongruent), part of speech (Noun versus Verb), and sex. The raw data and complete summary tables for the analyses are presented in Appendices C and D respectively.

List I. The mean trials to criterion are shown in Table 2. Verb-biased lists were found to be significantly more difficult than the noun-biased, $F(1,32) = 8.65$, $p < .01$. This difference however depended upon both the semantic similarity of the stimulus encodings and the transfer paradigm. Under the A-Br condition, part of speech and semantic similarity interacted, $F(1,32) = 4.49$, $p < .05$, such that the difference between noun-biased and verb-biased stimuli was found only for the noncongruent stimuli. Under the C-B condition the noun-biased stimuli were easier for both A-Br and C-B. The interaction of part of speech and semantic similarity obtained with the A-Br condition, and the absence of this interact under the C-B condition led to a significant three-factor interaction, $F(1,32) = 4.49$, $p < .05$. As the paradigm manipulation (A-Br, C-B) is only relevant for the second list, this three-way interaction must be attributable to a sampling error. This difference must be considered in the interpretation of List II.

List II. Performance on the second list was analyzed in terms

Table 2

Experiment II: List I

Mean Trials to Criterion

	High Recodeable		Low Recodeable	
Stimuli	A-Br	C-B	A-Br	C-B
Congruent-Noun	9.25	3.50	4.75	6.25
Congruent-Verb	4.50	6.75	7.25	10.00
Noncongruent-Noun	4.00	5.50	6.50	7.00
Noncongruent-Verb	14.50	6.50	18.25	13.00

of trials to criterion of one-perfect trial. The mean trials to this criterion for each condition are shown in Table 3. The paradigm effect was highly significant, $F(1,32) = 21.37$, $p < .01$. The superiority of the High- over the Low-Recodeability condition approached significance, $F(1,32) = 2.94$, $p < .10$. However paradigm and recodeability did not interact, $F < 1$. Thus it appears that the recoding manipulation has not produced a decrease in the difference between the A-Br and C-B conditions, as expected on the basis of the recoding hypothesis.

The interaction between recodeability and part of speech was significant, $F(1,32) = 11.97$, $p < .01$. It can be seen from Table 4 that for the High-Recodeability condition the noun-biased form of the stimuli are the more difficult, while for the Low-Recodeability condition the verb-biased form is the more difficult. Since all subjects under the High-Recodeability condition had first lists which differed in part of speech from that of the second list, this result indicates that higher performance is associated with a subject's learning a first list with noun-biased stimuli. The three-way interaction of paradigm, recodeability and semantic similarity of encodings was also significant, $F(1,32) = 4.75$, $p < .05$. Figure 1 shows the Paradigm by Recodeability interactions for congruent and noncongruent stimuli. Thus it appears that with semantically discriminable encodings that the effects or re-pairing the stimulus and response terms are mitigated by the provision of stimulus recoding opportunities.

Finally a sex difference was found in terms of a superior performance for females, $F(1,32) = 4.26$, $p < .05$. Sex did not, however,

Table 3

Experiment II: List II

Mean Trials to Criterion

Stimuli	High Recodeable A-Br	High Recodeable C-B	Low Recodeable A-Br	Low Recodeable C-B
Congruent-Noun	13.75	7.75	6.50	6.00
Congruent-Verb	5.75	4.50	10.25	9.00
Noncongruent-Noun	10.00	5.00	13.00	3.50
Noncongruent-Verb	7.75	4.00	18.75	6.25

Note: The cells of this table are labelled so that the stimuli are designated as presented on List II. It should be noted that identically labelled cells in Tables 2 and 3 may represent contributions of different subjects. For example, in Table 3 the mean for the High-Recodeable, A-Br condition with congruent-noun stimuli, and in Table 2 the mean for the High-Recodeable A-Br condition with congruent-verb stimuli are based on the same subjects.

Table 4

Experiment II: List II

Mean Trials to Criterion, Interaction of Part of Speech and Recodeability

	Recodeability	
Part of Speech	High	Low
Noun	9.13	7.25
Verb	5.50	11.06

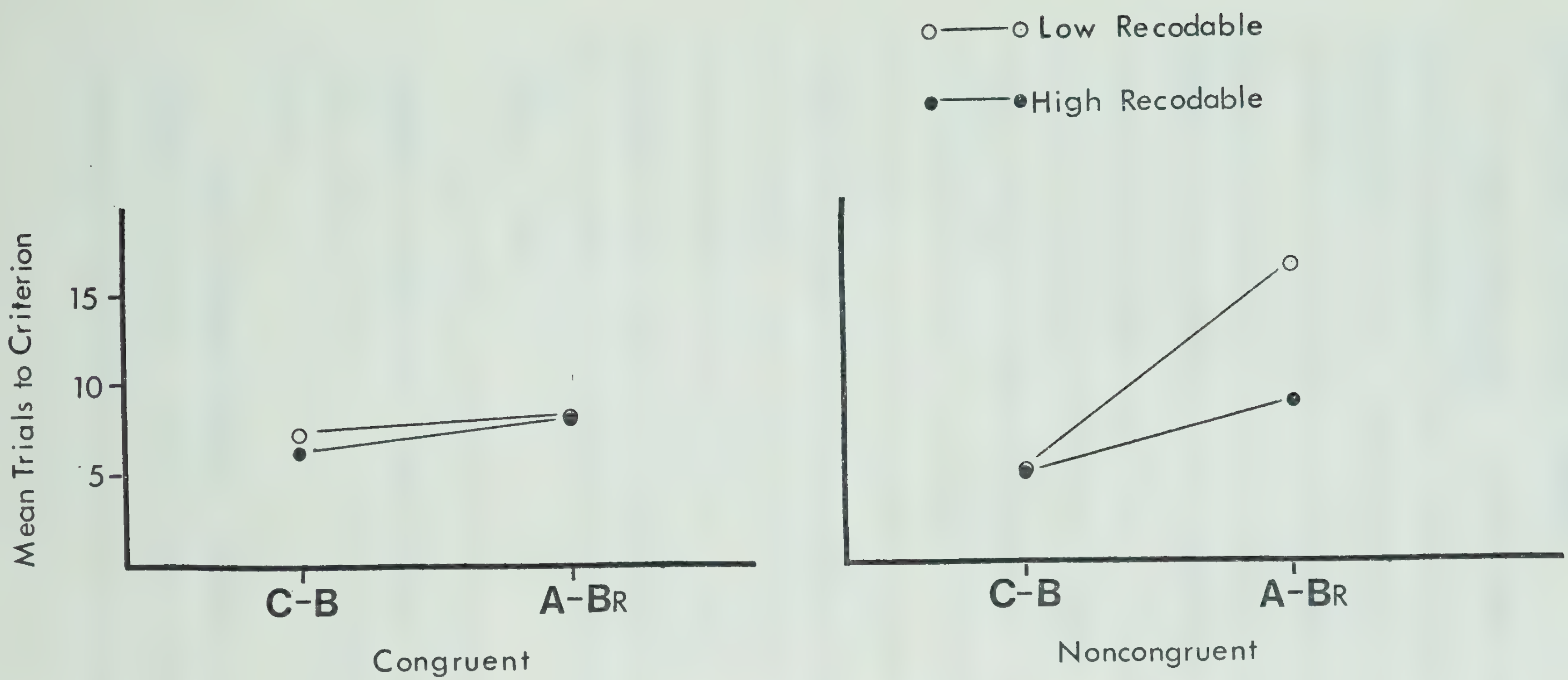

Figure 1: Experiment II: List II Recodeability by Paradigm interaction for congruent and noncongruent stimuli.

interact with any other variable.

List I Relearning. Table 5 shows the mean number of test trials to relearn the first list, with the first test trial being the unpaced recall trial. Significantly more trials were required to re-learn the A-B list following A-Br interpolated learning than for C-B, $F(1,32) = 30.82$, $p < .01$. It should be noted that neither the main effect of recodeability nor the interaction of codeability, Stimulus Set and Paradigm were significant. The difference between the Noun and Verb condition paralleled that found in List I with the Noun condition showing the superior performance, $F(1,32) = 11.77$, $p < .01$. Two interactions must be considered in interpreting this difference. The interaction of part of speech and paradigm was significant, reflecting the fact that the noun-biased stimuli were easier under the A-Br condition. This effect parallels again that found in both the first and second lists, $F(1,32) = 13.54$, $p < .01$. The superiority of the noun-biased condition was also found to be primarily for males. The interaction of sex and part of speech was significant, $F(1,32) = 7.19$, $p < .025$.

In addition a significant four-factor interaction between Paradigm, Recodeability, Part of Speech, and Semantic Similarity was found, $F(1,32) = 11.77$, $p < .01$. No interpretation of this seems obvious.

List I Unpaced Recall. The mean total correct recalls for each condition are shown in Table 5. The only effects that reached significance in this analysis were the difference between paradigms,

Table 5

Mean Trials to Relearn List I and Mean Correct on Initial Unpaced Test Trial, Experiment II

	High Recodeable		Low Recodeable	
Stimuli	A-Br	C-B	A-Br	C-B
Congruent-Noun	3.00	2.00	4.25	1.50
	(5.25)	(7.25)	(4.00)	(6.75)
Congruent-Verb	8.75	1.50	6.25	4.50
	(4.00)	(6.50)	(3.75)	(6.50)
Noncongruent-Noun	4.00	2.25	4.00	5.75
	(3.50)	(5.75)	(4.25)	(5.75)
Noncongruent-Verb	6.75	3.50	7.75	1.50
	(3.25)	(6.00)	(3.00)	(7.50)

Note: Mean correct on the initial unpaced test trial are in parentheses.

$\underline{F}(1,32) = 28.45$, $\underline{p} < .01$, and the interaction of sex and stimulus semantic similarity, $\underline{F}(1,32) = 5.82$, $\underline{p} < .05$. This interaction reflects the better performance of males recalling the congruent stimuli and the better performance of the females recalling the noncongruent stimuli.

Experiment III

The results of Experiment II offered some support to the stimulus recoding hypothesis. If only the noncongruent stimuli are considered, it can be seen that in terms of transfer performance, the provision of recoding cues reduces the difference between the A-Br and C-B conditions. While this interpretation of these results is appealing the possibility of a sampling error must be considered.

In List I, it should be recalled (See Table 2), the subjects learning the verb-biased noncongruent-stimulus lists under the A-Br condition performed at the lowest level, particularly in the Low-Recodeability condition. In List II it is these latter subjects which provide the lowest level of performance. In fact it would appear that the interaction of paradigm and recodeability for the noncongruent stimuli reflects not a facilitation in the High-recodeable condition but rather a lowering of A-Br performance in the Low-recoding condition as a result of the inclusion in this condition of subjects that on the basis of their first-list performance appear to be less efficient in learning such lists. Also it can be seen that subjects learning the A-Br list under the Noncongruent-High Recodeability conditions perform at a level similar to that of subjects learning the A-Br list with the congruent encodings. Of course this may merely indicate that the noncongruent items are more difficult to learn. This is not however likely in as much as no such difference was found under the C-B conditions.

On the bases of these considerations one is inclined to put little faith in the evidence of this study as supporting the stimulus recoding position. This conclusion is further supported by the observation that no interaction of Paradigm Recodeability and Semantic Similarity of cues was found with either measure of A-B recall. If the subjects were in fact able to recode the stimulus terms so that they could eliminate interference, one would expect this to produce a facilitation in terms of an increased A-B recall since presumably there would have been less unlearning of the A-B recall association.

The failure of the recoding manipulations of Experiments I and II to provide any clear evidence of a facilitation in A-Br as a function of stimulus recoding suggests the possibility that stimulus recoding might be more difficult than previously supposed. Experiment III, therefore, was an attempt to produce stimulus recoding in an A-Br condition in a situation which one would presume to maximize the likelihood that a subject would utilize such a strategy. To that end subjects were presented with word pair stimuli. The words composing the compound stimulus could be distinguished on the basis of their membership in one of two categories. The subjects would, therefore, be instructed to select the word which was the member of category Q as the stimulus to be associated with the response. To maximize the subject's attention to the relevant stimuli they were also instructed to read aloud the relevant stimulus fraction on study trials. To further ensure that no advantage could acrue from attending to the irrelevant stimulus, only the relevant stimulus component was

presented on the test trial. Richardson (1971) reported that a similar procedure resulted in very efficient stimulus selection with CCC's. It should be noted that the stimuli used in this study were similar to low-meaningful stimuli in that they could be fractionated. However the selection rule for low-meaningful stimuli is generally of the form "select position A". This is independent of the content of the item at position A. With the present stimuli the selection rule demanded that a decision be made as to the semantic nature of the stimulus before selection of the appropriate encoding. The order of presentation of the two words were varied so that positional cues could not be used and to ensure that the subject processed both terms at some level on all trials.

Method

Lists. The stimulus terms for this study were word pairs consisting of an animal and an article of household furnishings. Six such pairs were used in each of two sets of stimuli and were paired with the digits 2 to 7. Within each list the items were selected so that within a category the words were easily discriminated thus reducing possible intralist interference. The lists are presented in Appendix A.

Design. In this study, Transfer Paradigm and Recodeability were varied factorially as in Experiment II. Recodeability was manipulated by requiring subjects in the Low-Recodeability condition to select the same category during both A-B and transfer learning and by requiring the subjects in the High-Recodeability condition to select alternate categories on the two lists. The paradigm manipulation involved either presenting the same (A-Br) or different (C-B) stimulus items within each category on the transfer list. Table 6 shows possible first list items for each of the four conditions when the subject was required to learn the association Dog - 7 in the transfer list.

The design was also completely counterbalanced so that each stimulus set appeared equally often in all lists and each category was relevant equally often. The complete design was therefore a 2 x 2 x 2 x 2 x 2 factorial, with factors of paradigm, recodeability, encoding category, sex, and stimulus set. The factor of stimulus set was included for purposes of generality and indicates that two independent sets of animal-furniture compounds were used in this

Table 6

Sample First-List Item for a Given Second-List Item:

Study: Dog Chair 7, Test: Dog

	Recodeability	
Paradigm	High	Low
A-Br		
Study	Dog Chair 6	Dog Chair 6
Test	Chair 6	Dog 6
C-B		
Study	Cow Table 6	Cow Table 6
Test	Table 6	Cow 6

experiment. Sixty-four subjects served to replicate the design twice. The subjects were from the same source as the previous experiment.

Procedure. All lists were learned by the study-test procedure on a Stowe Memory Drum at a 2-second rate. Prior to learning each list the subjects were informed as to the relevant category and as to the presentation of the relevant stimulus only, on the test trials. The subjects were instructed specifically to ignore the irrelevant stimulus terms.

The criterion for the first list was one-perfect-test trial and for the second list two-perfect-test trials plus two overlearning trials. As in Experiment II, retention of the A-B association was tested by an unpaced cued recall trial followed by study-test relearning trials. See Appendix B for the instructions to subjects.

Results

Performances on all lists were analyzed as 2 x 2 x 2 x 2 x 2 factorial designs with factors of transfer paradigm, recodeability, stimulus set, encoding category, and sex. The complete analysis of variance summary tables and raw data are presented in Appendices D and C respectively.

List I. The only effect to reach significance was a four-factor interaction of recodeability, sex, encoding category, and stimulus set, $F(1,32) = 10.33$, $p < .01$. As recodeability is relevant as a variable only in terms of the subject's List II this effect cannot be interpreted.

List II. The mean trials to a criterion of one perfect trial are shown in Table 7 for the four recodeability and transfer paradigm combinations. The main effect of Transfer Paradigm, $F(1,32) = 20.27$, $p < .01$ and its interaction with Recodeability, $F(1,32) = 4.61$, $p < .05$ were significant. A t-test between the High- and Low-recodeability conditions under A-Br shows that the High-Recodeability condition is significantly better, $t(31) = 2.84$, $p < .01$. In addition the difference between the two transfer paradigms was maintained under the High-recodeability condition, $t(32) = 2.44$, $p < .05$.

The only other significant effect was a Recodeability x Sex x Encoding Category interaction, $F(1,32) = 11.86$, $p < .01$. This can be attributed to the males performing better when furniture was the relevant category on List I while females performed better if animals were relevant.

Table 7

Experiment III List II

Mean Trials to Criterion

	Paradigm	
Recodeability	A-Br	C-B
High	6.54	4.69
Low	8.75	3.56

List I Relearning. The mean trials to relearn the first list to the original criterion are shown in Table 8. The only effects to reach significance were the effect of paradigm and its interaction with recodeability, F's$(1,32) = 15.96$ and 9.33, $p < .01$, respectively.

List II Unpaced Recall. The results of this analysis were very similar to those of the relearning analysis. The effect of paradigm was significant, $F(1,32) = 11.76$, $p < .01$ and the interaction of paradigm and recodeability approached significance, $F(1,32) = 3.08$, $p < .10$.

Discussion

It is clear from the transfer analysis that given a close control of the subject's encoding or selection behavior that it is possible to obtain a mitigation of the effects of stimulus re-pairing in the paired-associate task. In addition the analysis of A-B recall indicates very little retroactive inhibition in the A-Br condition when subjects are strongly primed to recode the stimulus terms.

Since the subjects processing of the irrelevant items was so closely limited by the task demands, it is perhaps surprising that an effect of re-pairing was obtained under the Recoding condition. This effect was rather unstable in that it reached significance only with the transfer analysis. However, the means were ordered in the same manner for the recall and transfer analyses. It is not clear, whether this effect of response re-pairing represents the effects of associative interference, or some difficulty in changing the encoding category on List II. To the extent that the subjects in learning the A-B list

Table 8

Experiment III: List I Recall

Mean Trials to Relearn and Mean Correct

on First Unpaced Test Trial

	Paradigm	
Recodeability	A-Br	C-B
High	2.94	2.56
	(3.75)	(4.38)
Low	4.62	1.80
	(2.69)	(4.62)

Note: The mean correct on the unpaced test trial are shown in parentheses.

fail to limit processing of items in the appropriate category, so that inappropriate associations are formed, one would expect some difficulty with the re-pairing of the response terms. It is however interesting to note that in the C-B condition there is also an indication that even when the stimulus terms are changed subjects still find the recoding condition more difficult. This however was not statistically reliable.

The reports of the subjects also indicated that their attention was limited very much to the appropriate encoding. In the C-B conditions many were uncertain as to the specific items which were presented as instances in the irrelevant category. In fact when asked to pick these words out of a list, a considerable number made errors. Since the subject had to attend to each item sufficiently to determine its class membership this is rather interesting. A further indication that the subjects did limit attention to the irrelevant category items was provided by the subjects in the A-Br recoding condition. Many of these subjects reported that they thought that the number paired with the word pair in List II was the same as that paired in List I. They assumed their task to be merely to associate the response first to one word and then to the other. When asked to indicate which words were paired they mediated between the response which they presumed to be associated to each word of the pair. That these subjects failed even to recognize that there had been any response re-pairing after both A-Br learning and A-B relearning does strongly suggest that they were very efficient in attending to the irrelevant category items only

sufficiently to reject them from further processing. In fact, that some subjects failed even to recognize the irrelevant items within a list after having experienced A-B, learning transfer and A-B relearning suggests the possibility that the processing of the irrelevant stimulus components was a function of short-term memory only.

General Discussion

If one is to draw a conclusion from these studies, it must be that stimulus recoding is neither as obvious nor as facile a solution to the problem of interference as Martin's original conceptualization would suggest. The failure to support the hypothesis, which at first glance seems obvious in its simplicity, is not unique to the present research. Similar findings have been reported elsewhere, (Weaver, McCann, and Wehr, 1970; Goggin and Martin, 1971; Underwood and Williams, 1971). Since a variety of stimuli have been used from CCC's (Underwood and Williams, 1971) to colored geometric forms (Goggin and Martin, 1971) to high-meaningful words (present research) this phenomenon does appear to be quite general. In light of this it is perhaps advisable to reconsider the question of stimulus recoding in the paired-associate task, for the situation is more complex than previously suggested.

Consideration of this problem is divided into two main sections. The first shall deal with the question of those conditions which must be fulfilled before it is logically possible for the subject to recode. Subsequently consideration will be given to possible explanations as to why subjects might still fail to find any advantage in stimulus recoding even under conditions which would allow for such a strategy.

If stimuli are to be recoded it is obviously necessary that the stimuli possess at least two encodings. With most stimuli this poses no problem as they generally are, in fact encodeable on a number of dimensions. This is not to say that a subject will use a

particular dimension for encoding. Utilization would seem to be a function of such factors as the encoding predilections the subject brings to the experimental situation, the particular instructions provided by the experimenter, and possibly the subject's previous experience under such conditions. These factors will be of some concern later in this discussion.

It is not sufficient that there merely be available two or more encodings for each stimulus. As was suggested in the introduction to this paper, one may conceive of the recoding process as being in itself an interference paradigm. To briefly review this argument, it should be noted that if the first encoding of a stimulus is interpreted as a response to the stimulus presented by the experimenter, the recoding of that stimulus may be looked upon as learning to associate a new encoding response to an old stimulus. Martin (1968) has argued that if the subject selects that encoding which was relevant on the previous list, interference which is aversive, should occur. The argument presented here is that if the subject recodes to avoid the interference that results when he persists with the old encoding, he will merely exchange that interference which results from having to learn a new response to an old functional stimulus for the interference which results from having to learn a new encoding response to an old nominal stimulus.

It should be mentioned at this point, that one implication of Martin's argument is that the effect of presenting an interfering list is "somehow", perhaps to reinstate the original encoding variability

so that the subject may sample again from the encoding possibilites. One suggestion that Martin puts forth is that "...it is differentially conditioned collateral inhibition that underlies the reduced probability of alternative encodings, [therefore] it makes reasonably good sense to say that the nonreinforcements that initiate Task 2 learning cause disinhibition and thereby reintroduction of encoding variability". This does, however, seem inconsistent with the view that subjects find the initial encoding of such stimuli to be very difficult. Certainly one would expect that the encoding response to each stimulus is exceedingly well learned, so that it would be difficult to disrupt such an association. From the point of view of the subject it might well be that the presentation of stimuli of low meaningfulness which have been stably encoded in a paired-associate task is of some advantage. At least he (the subject) does not have to find a stable encoding for such a stimulus. In this respect the transfer situation for high- and low-meaningful stimuli would appear to be functionally identical. Interestingly Martin's results give elegant support to this position in that no difference was found between the High- and Low-meaningfulness conditions in the A-Br paradigm. The evidence for the stimulus recoding position was based entirely upon the difference between the High- and Low-meaningfulness conditions for the C-B paradigm, (See Table 1). Two explanations of the interaction of Stimulus Meaningfulness and Transfer Paradigm obtained by Martin are, therefore, possible. One is that with low-meaningful stimuli and response re-pairing, subjects recode the stimulus terms thus

reducing associative interference. The other is that with low-meaningful stimuli and response re-pairing, subjects do not recode the stimulus terms and thereby reduce encoding variability. Martin has recognized this possibility (Martin and Carey, 1971) in light of his own failure to obtain stimulus recoding facilitation in a study which manipulated stimulus encoding in a manner which allowed for the comparison of recoding and nonrecoding A-Br conditions (Goggin and Martin, 1971). None-the-less it is still possible that under certain conditions one may overcome the subject's tendency to persist in using previously relevant encoding in transfer.

One possible way in which one might eliminate the interference engendered by recoding stimuli would be to use stimuli which are encodeable according to rules so that each item in the list may have an encoding defined by the application of the rule. Recoding would then involve changing the rule in the transfer list. Presumably this would be easier than learning a new encoding response to each stimulus. Thus one might assume that if a set of stimuli can be encoded first according to one rule and then according to another rule subjects will be able to utilize this and thus eliminate interference in the A-Br condition. The data does not support this position in that several studies which used stimuli that did conform to these conditions failed to find any such facilitation, (Goggin and Martin, 1971; Underwood and Williams, 1971; and the present research, Experiments I and II). With respect to these failures one must conclude that recoding is an unpreferred strategy, either because it does not eliminate interference

or because it is in itself difficult. Of course these are not in any way exclusive so that in most cases one would expect that both possibilities are operating. These will be considered successively.

The stimulus recoding position assumes that if the subject utilized a different functional stimulus in transfer the interference expected on the basis of having the same nominal stimuli will be reduced. This assumes that the new functional stimulus will have little association with the first-list response. This requires the assumption that in the learning of the first list the subject did not utilize this encoding to any great extent in attempting to learn the list. The advantage of stimulus recoding would seem to be a direct function of the efficiency with which the subject encodes the A-B list.

The studies which have purported to investigate the effect of stimulus recoding in the interference transfer paradigm differ widely in respect to the control of the subject's initial encoding that was obtained. In the Goggin and Martin (1971) study which employed colored-geometric shapes the level of this control would seem to have been quite low. Since the stimuli varied on two dimensions, color and form, these investigators attempted to force the subject to encode along one dimension by making the other noninformative. Since the subject was not informed of this presumably he paid considerable attention to both dimensions and quite possibly formed associations between the response and the "non-selected" cue.

Williams and Underwood (1971) seem to have better control of the subjects initial encoding, in that they informed the subjects as

to the appropriate initial encoding (by coloring the to-be-selected-letter red). In fact they also report data from the backward recall to the stimulus components which also seems to indicate that the association between the response and the appropriate encoding is much stronger. One must suspect that their failure to obtain a facilitation is not attributable entirely to a failure of recoding to eliminate this associative interference.

In the three experiments reported here, the subjects in all cases were directed to the initial encoding. The studies differ however in the likelihood that the subject's attention to the alternative encodings was controlled. In Experiment I it would seem quite possible that the subjects did notice the multiple meanings of each of the recodeable stimuli. The fact that these were more difficult to learn suggests that they might indeed have functioned in a manner similar to low-meaningful stimuli in that they exhibited encoding variability. In Experiment II this would seem to be a less likely possibility in that the linguistic cues would seem to predispose the subject to the correct interpretation, that is the experimenter-designated interpretation. In Experiment III this factor seems to be under rather complete control in that the subject's attention to the irrelevant stimulus terms is limited to that which occurs in deciding that this is the term to be ignored. Also in this case since only the relevant encoding was presented on test trials as a cue for recall there would seem to have been no advantage to the subject in failing to obey the instructions to ignore the category designated by the experimenter as irrelevant.

The advantage of stimulus recoding, if it does occur, would seem to be reduced by any procedure which allows the subject to select that encoding which is to be used in transfer during his learning of the first-list association. It is possible that recoding under conditions of stimulus selection may reduce interference in that the association of the response with the "nonselected stimulus components" might be less strong and therefore more readily unlearned. However the existence of such interfering associations might also decrease the likelihood that a subject would perceive any advantage in using such a new encoding. Certainly it would mitigate against any spontaneous recoding of the stimuli by the subject when the recoding cues are relatively weak.

At this point it would perhaps be advisable to recapitualate the argument thus far. There are three main points. In paired-associate learning recoding of the stimulus terms in transfer is predicated upon the availability of at least two encodings for each stimulus term, rules for the defining of the appropriate encoding for each stimulus and control of the subject's initial encoding of the stimulus terms.

It should, however be noted that if a subject does recode, failure to control his initial encoding should decrease the advantage of stimulus recoding. It cannot however, account for a failure to obtain any facilitation. Two studies which have attempted to control the subject's initial encodings are Williams and Underwood (1971) and Experiment II of the present research. In both of these studies

rather extreme measures were taken to ensure that the subjects did recode, yet neither study provides any convincing support for the recoding hypothesis. It does seem possible that stimulus recoding is a very difficult strategy for a subject to employ. It has been assumed in the planning of the present research that it is relatively easy for a subject to change from one encoding rule to another in paired-associate learning. Perhaps, this is difficult for a subject so that he persists in using the previously relevant encoding rule. If this is so, it is possible that in both the first and transfer lists the subject may use the encodings designated by the experimenter, but since changing encodings is difficult his transfer performance will be less impressive than expected on the basis of the stimulus recoding hypothesis.

A possible explanation of why this might be the case will be considered, with particular reference to Experiment II. Although the discussion that is to follow will be primarily limited to this experiment, many of the considerations will be applicable to other stimulus presentations.

One factor that presumably makes paired-associate learning difficult is high encoding variability in the stimulus terms (Martin, 1968). Encoding variability demands not merely that there be several encodings for a stimulus, but also that several encodings be of sufficient strength that they can compete for the subject's attention during the encoding of the stimulus terms. Thus in the case of meaningful stimuli, for example, the encodings which are analogous to those used with low-meaningful stimuli (that is, individual letter encodings) do

not compete with the more potent semantic encodings. When subjects are presented with words of multiple semantic encoding possibilities, however, they may indeed have some difficulty in selecting an appropriate encoding. Yet it does seem unlikely that this would be a problem of any magnitude under conditions such as those employed in Experiment II. Here the subject is in the first list given clear hints as to which encoding is appropriate for this situation. Thus it seems unlikely that a subject presented with the stimulus "I hide" would fail to encode it in terms of its meaning "to conceal". It would appear that the function of the "I" is to set the subject to expect a verb. This will then prime one of the semantic interpretations of the stimulus term. Once this interpretation has been made, however, the subject might well regard the prefix word as redundant. For the subject the stimulus becomes "hide" which means "to conceal".

The situation with more fractionable stimuli such as those used in Experiment III and in experiments with low meaningful stimuli is quite different. In these cases one can conceive of the subject making a relatively peripheral response in which he directs his attention to the appropriate encoding. In this case the encoding of the stimulus, that is, the selection of the appropriate fraction, and the interpretation of the functional stimulus, that is, the reading out of the encoding, are successive and independent events. It is doubtful that this is the case in Experiment II, for this would imply that the subject responds to the stimulus "hide" as "verb" and "to conceal" successively.

If the subject is asked to recode the stimulus terms the situation is altered severely. With low-meaningful stimuli or fractionable stimuli, a subject can be instructed to use the previously nonselected encoding. While the subject may be reluctant to do this it is also clear that once a subject is forced to recode in this manner the previously relevant encoding is no longer available for processing to the same extent as previously. Thus in Experiment III subjects experienced little interference in the recoding condition when the responses were re-paired. In this case one suspects that the subjects attended to the irrelevant encoding merely long enough to decide that it was irrelevant.

In Experiment II the situation was quite different. The subject presumably had encoded each of the stimulus terms according to one semantic interpretation. He may also have learned to ignore the redundant linguistic cue to some extent. In the transfer task he was presented with the same stimulus, which on the basis of the subjects' List I training, one would expect to have evoked a consistent semantic encoding response. In addition the subject was also presented with cues which could prime the evocation of an alternative encoding response. It seem likely that both encodings would have been well above threshold on this list. The situation could be regarded as one of high encoding variability in which the subject might vacilate between the alternative encodings. Under these circumstances it is likely that the subject would find the learning of the transfer list to be difficult. He might even have failed to stimulus recode on the transfer

list, but given that the linguistic encoding cue was persistently presented this failure seems somewhat unlikely.

The foregoing analysis would suggest that subjects might find it extremely difficult if not impossible to eliminate interference in a paired-associate learning task by the recoding of high-meaningful stimuli along a semantic dimension. The experimental evidence supporting this contention that provision of semantic recoding cues with high-meaningful stimuli in paired-associate learning is unlikely to mitigate the effects of associative interference is limited by two factors. First, the use of homonyms that differ in terms of their part of speech confounds recoding along semantic and syntactic dimensions. Second, there is some very slight evidence from Experiment II for the stimulus recoding hypothesis. It should be recalled that the expected facilitation was obtained with stimuli of nonsimilar semantic encodings. While this did appear to be a sampling error, particularly in view of the fact that neither measure of retroaction offered any support for the hypothesis, it would seem advisable to replicate this experiment, perhaps with an alternative means of obtaining stimulus recoding.

To conclude, it has been demonstrated (Experiment III) that it is possible to obtain a facilitation attributable to stimulus recoding under conditions which minimize the subjects' processing of the irrelevant stimulus attributes during original and transfer learning. In most cases attempts to demonstrate a facilitation in paired-associate transfer as a function of stimulus recoding have not been successful. Several hypotheses have been suggested to account for these failures. Unfortunately, no one hypothesis seems able to account for every case.

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Appendix A

Stimulus Materials

Table 1

Assignment of Lists to Conditions
for Experiment I

Condition		List I	List II
Experimental	Noun-Verb	I	V
Experimental	Noun-Verb	VIII	IV
Experimental	Verb-Noun	V	I
Experimental	Verb-Noun	IV	VIII
Control	Noun-Noun	VI	I
Control	Noun-Noun	III	VIII
Control	Verb-Verb	II	V
Control	Verb-Verb	VII	IV

Note.--Lists I to VIII are presented in Appendix A, Table 2.

Table 2

Lists for Experiment I

I		II		III		IV	
BIRD	3	SING	3	BIRD	3	SING	3
CHILD	7	SAVE	7	CHILD	7	SAVE	7
HOTEL	8	PROVE	8	HOTEL	8	PROVE	8
PATH	1	LIKE	1	PATH	1	LIKE	1
MAN	12	HIRE	12	MAN	12	HIRE	12
SCHOOL	5	FAIL	5	SCHOOL	5	FAIL	5
BARK	2	BARK	2	BANK	2	BANK	2
DEAL	11	DEAL	11	FLY	11	FLY	11
LEAD	10	LEAD	10	HIDE	10	HIDE	10
WOUND	6	WOUND	6	SCALE	6	SCALE	6
TEAR	4	TEAR	4	IRON	4	IRON	4
LAND	9	LAND	9	REFUSE	9	REFUSE	9

V		VI		VII		VIII	
BRING	7	CAT	7	BRING	7	CAT	7
GIVE	5	DESK	5	GIVE	5	DESK	5
JOIN	3	GIFT	3	JOIN	3	GIFT	3
SPEND	12	LAKE	12	SPEND	12	LAKE	12
RAN	1	SHOE	1	RAN	1	SHOE	1
KILL	8	KITCHEN	8	KILL	8	KITCHEN	8
BARK	11	BARK	11	BANK	11	BANK	11
DEAL	9	DEAL	9	FLY	9	FLY	9
LEAD	2	LEAD	2	HIDE	2	HIDE	2
WOUND	4	WOUND	4	SCALE	4	SCALE	4
TEAR	6	TEAR	6	IRON	6	IRON	6
LAND	10	LAND	10	REFUSE	10	REFUSE	10

Table 3

Lists for Experiment II

Stimuli		Responses	
Noncongruent	Congruent	List I	List II
JAR	BITE	9	4
SIGN	RACE	5	8
LOAF	VISIT	6	9
MIND	IRON	4	3
FLY	KNOCK	7	6
TRAIN	CALL	3	5
HIDE	DRUM	8	2
WAVE	GREASE	2	7

Table 4

Lists for Experiment III

Stimulus Set A		Stimulus Set B		Responses	
Animal	Furniture	Animal	Furniture	List I	List II
WHALE	CABINET	FROG	RADIO	3	2
PENGUIN	BED	ALLIGATOR	FRIDGE	6	7
FOX	LAMP	GIRAFFE	SOFA	2	5
MONKEY	TABLE	RABBIT	BOOKCASE	4	6
KANGAROO	RUG	PIG	TOASTER	7	4
BAT	STOVE	HORSE	DESK	5	3

Appendix B

Instructions to Ss

Instructions to Ss Experiment I

List I

This is an experiment concerned with learning processes. We are interested in determining the conditions which produce changes in the rate at which people learn verbal material. The knowledge gained from these studies is expected to have important implications for the understanding of the learning process.

The items you are to learn consist of word-number pairs like the pair on this card (show card). Your task will be to learn to associate or connect the number with the word, so that you will be able to say the number when the word is presented alone. The numbers used in this experiment are 1 through 12. Each number will be paired with a different word.

Learn the pairs as pairs and not the order in which they are presented since this order will change each time we go through the list. Try to make an association between the members of each pair.

The procedure is a simple one. There will be alternating study trials and test trials. On study trials study the pairs silently. On test trials the words will be presented alone. You are to attempt to say the number that was paired with the word. You must respond quickly, as a

response after the next word has appeared can not be counted. Remember to respond on every test trial--whether or not you got that item correct on the previous test trial. That is, you are to attempt to say the number that was paired with the word whenever the word is presented alone. It is perfectly all right to guess. Errors will not count against you in any way.

A yellowish tape in the window like the one there now indicates that you have finished one type of trial and are about to begin another.

On a study trial try to learn each pair as it is presented. Do not concentrate all your effort on just a few pairs. Instead study the pairs as they are presented.

Remember on study trials study the pairs silently and on test trials try to recall aloud the number that was paired with the word when the word is presented alone. These two types of trial will alternate. I will tell you when you are to stop.

Are there any questions?

Would you briefly describe your task to me?

List II

Now that you have learned a list of word-number pairs your task will be to learn another such list. Again there will be study and test trials. In this list the responses are again the numbers 1 through 12.

Instructions to Ss Experiment II

List I

In this experiment we are interested in the processes involved in learning to associate pairs of items so that when the first is presented the second can be recalled. In this experiment your task will be to learn 8 pairs of items. These pairs will consist of a word phrase paired with each of the digits from 2-9 like the pair on this card, (show card to S).

The procedure for learning the 8 pairs is quite simple. First you will be shown each of the items in the list. You are to study these aloud. It is important that on these study trials that you read everything that appears in the window aloud. Once you have seen every pair once you will then be given a test trial. On a test trial each word phrase will be shown and you will be required to call out the number. You do not need to read the words aloud on test trials. After you have been tested on every item you will be given another study trial. Thus we will alternate study and test trials.

On each trial the items will be presented in different orders so you must learn to associate each pair individually. Let us review this procedure.

1. On study trials read the word phrase and number aloud.
2. On test trials call aloud the number that was paired with the word phrase. Since the words will be presented quite quickly you must respond rapidly. A response after the next item has appeared can not be counted.
3. These study and test trials will alternate. I will tell you when you are to stop.

   Are there any questions?

<u>List II</u>

Now that you have learned a list of word-phrase-number pairs your task will be to learn another such list. In this list there will again be word phrases and numbers. The numbers will again be the digits 2-9. Before you are to learn this list, however, there is something else you must do.

I will show you each word phrase that is to be used in this list. I want you to give a definition for the phrase and to use it in a sentence. After you have done this you will then learn the second list. The procedure will be identical to that used in List I. Remember to read aloud the word phrase and number on study trials.

Are there any questions?

List I Relearning

I am now going to show you the word phrases you saw in list I. I want you to give me the number that was paired with the phrase in List I. I will pace the machine so you may take your time.

After you have attempted to recall all the numbers you will begin a study trial to relearn the list. This will be exactly as in the first list. Remember to read aloud the word phrase on study trials. The relearning trials will be at the same rate as before so you will have to respond quickly. I will tell you when you are to stop.

Are there any questions?

Instructions to *Ss* Experiment III

List I

This is an experiment in learning processes. We are interested in the variables that affect the rate at which people learn verbal mareria1. In this experiment your task will be to learn to associate words with numbers so that when I show you the word alone you will be able to say the number that goes with it. The words in this experiment will be the mames of household furnishings. There will be six such words and each will be paired with one of the digits from 2-7.

The procedure for learning these associations is quite simple . First you will be shown each of the word-number pairs. You are to read the word and the number aloud. After you have seen every item in the list you will be given a test trial. On a test trial only the name of the household furnishing will be presented. You are to call out the number that was paired with the word. If you are not certain of the correct number guess. Errors will not count against you . After you have been tested on every item you will begin a new study trial. Thus we will alternate study and test trials. The order in which the items will be presented will vary from trial to trial to you will have to learn to associate each pair individually. On test trials you will have only a few seconds to think of and say the correct number.

If you call out the number after the next item has appeared it may not be counted.

Now there is one additional complication. On study trials when you are shown the word and the number you will also see another word besides the name of the household furnishing. It may be to the right or to the left and will always be the name of an animal . You are to ignore this word. You are not to read it aloud. On test trials you will be shown only the name of the household furnishing.

Let us review briefly this procedure. On study trials you will be shown two words paired with a number. You are to read the name of the household furnishing and the number aloud. On the test trial only the name of the household furnishing will be shown. You are to call aloud the number that was paired with it on the study trial . It is not necessary to read the name of the household furnishing aloud on the test trial. In fact you may find it advantageous not to as you will have more time to say the number.

Are there any questions?

<u>List II</u>

Now that you have learned a list of word-number pairs, your task will be to learn another such list.

<u>High</u> recodability groups. The procedure will be identical to that used in the first list, except that you are to read the mame of the animal aloud. On the test trial only the name of the animal will be shown.

<u>Low recodability groups.</u> The procedure will be identical to that used in the first list. Remember to read aloud the name of the household furnishing on study trials

<u>List I Relearning</u>

I am now going to show you the list that you learned first so that we can determine how much you can remember. You will be shown the names of the household furnishings first You are to attempt to recall the number that was paired with each word. Once you have attempted the recall of all the numbers you will begin a study trial to relearn the list. While there will be no time limit on the first recall trial the following study and test trials will be at the same rate as before. Remember to read aloud the name of the household furnishing and the number on study trials. Are there any questions?

Note. For one half of the Ss the instructions had the animals and the household furnishings reversed.

Appendix C

Raw Data

Table 1

Raw Data Experiment I

S#	Bias: list I	Bias: List II	List I Data[a]: Context	List I Data[a]: Stimulus	List II Data[b]: Context	List II Data[b]: Stimulus
1	NOUN	VERB	2	4	58	50
2	NOUN	VERB	2	3	57	42
3	NOUN	VERB	14	15	28	27
4	NOUN	VERB	2	4	48	53
5	VERB	NOUN	3	8	58	47
6	VERB	NOUN	4	9	54	36
7	VERB	NOUN	10	4	58	47
8	VERB	NOUN	15	16	46	25
9	NOUN	VERB	4	6	47	24
10	NOUN	VERB	6	8	20	10
11	NOUN	VERB	3	8	49	32
12	NOUN	VERB	4	2	43	43
13	VERB	NOUN	1	3	60	55
14	VERB	NOUN	11	16	45	37
15	VERB	NOUN	8	11	51	28
16	VERB	NOUN	8	6	51	38
17	NOUN	NOUN	5	15	50	44
18	NOUN	NOUN	2	4	48	44
19	NOUN	NOUN	1	3	59	47
20	NOUN	NOUN	4	11	53	48
21	VERB	VERB	4	7	56	42
22	VERB	VERB	23	26	17	08
23	VERB	VERB	9	10	47	37
24	VERB	VERB	6	14	45	34
25	NOUN	NOUN	10	11	50	26
26	NOUN	NOUN	2	8	57	38
27	NOUN	NOUN	4	2	58	48
28	NOUN	NOUN	8	15	37	40
29	VERB	VERB	4	7	56	40
30	VERB	VERB	4	10	52	34
31	VERB	VERB	14	4	37	33
32	VERB	VERB	3	2	54	54

a trials to criterion of one perfect test trial

b totals correct over 10 trials

Table 2

Raw Data Experiment II
Trials to Criterion List I

	High-Recodable				Low-Recodable			
	S#	Sex	List*	Data	S#	Sex	List*	Data
A-Br Conditions	1	M	NC V	14	33	M	NC-N	7
	2	M	NC V	21	34	M	NC-N	5
	3	M	C V	6	35	M	C-N	7
	4	M	C V	5	36	M	C-N	3
	5	F	NC V	18	37	F	NC-N	9
	6	F	NC V	5	38	F	NC-N	5
	7	F	C V	5	39	F	C-N	6
	8	F	C V	2	40	F	C-N	3
	9	M	NC N	4	41	M	NC-V	14
	10	M	NC N	3	42	M	NC-V	6
	11	M	C N	13	43	M	C-V	15
	12	M	C N	5	44	M	C-V	2
	13	F	NC N	7	45	F	NC-V	27
	14	F	NC N	2	46	F	NC-V	26
	15	F	C N	16	47	F	C-V	6
	16	F	C N	3	48	F	C-V	6
C-B Conditions	17	M	C-V	11	49	M	C-N	11
	18	M	C-V	4	50	M	C-N	9
	19	M	NC-V	7	51	M	NC-N	3
	20	M	NC-V	3	52	M	NC-N	4
	21	F	C-V	5	53	F	C-N	4
	22	F	C-V	7	54	F	C-N	1
	23	F	NC-V	10	55	F	NC-N	18
	24	F	NC-V	6	56	F	NC-N	3
	25	M	C-N	2	57	M	C-V	3
	26	M	C-N	3	58	M	C-V	5
	27	M	NC-N	5	59	M	NC-V	5
	28	M	NC-N	6	60	M	NC-V	29
	29	F	C-N	4	61	F	C-V	6
	30	F	C-N	5	62	F	C-V	26
	31	F	NC-N	2	63	F	NC-V	11
	32	F	NC-N	9	64	F	NC-V	7

* Lists are classified as to the semantic similarity of the encodings (Congruent-C vs Noncongruent-NC) and as to the encoding biased (Noun-N vs Verb-V).

Table 3

Raw Data Experiment II
Trials to Criterion List II

	High-Recodable				Low-Recodable			
	S#	SEX	LIST*	DATA	S#	SEX	LIST*	DATA
A-Br Conditions	1	M	NC-N	11	33	M	NC-N	18
	2	M	NC-N	9	34	M	NC-N	11
	3	M	C -N	20	35	M	C -N	9
	4	M	C -N	18	36	M	C -N	4
	5	F	NC-N	12	37	F	NC-N	14
	6	F	NC-N	8	38	F	NC-N	9
	7	F	C -N	10	39	F	C -N	10
	8	F	C -N	7	40	F	C -N	3
	9	M	NC-V	5	41	M	NC-V	16
	10	M	NC-V	6	42	M	NC-V	22
	11	M	C -V	6	43	M	C -V	21
	12	M	C -V	6	44	M	C -V	5
	13	F	NC-V	13	45	F	NC-V	19
	14	F	NC-V	7	46	F	NC-V	18
	15	F	C -V	6	47	F	C -V	9
	16	F	C -V	5	48	F	C -V	6
C-B Conditions	17	M	NC-N	10	49	M	NC-N	5
	18	M	NC-N	4	50	M	NC-N	4
	19	M	C -N	14	51	M	C -N	5
	20	M	C -N	5	52	M	C -N	5
	21	F	NC-N	3	53	F	NC-N	3
	22	F	NC-N	3	54	F	NC-N	2
	23	F	C -N	10	55	F	C -N	12
	24	F	C -N	2	56	F	C -N	2
	25	M	NC-V	4	57	M	NC-V	6
	26	M	NC-V	4	58	M	NC-V	5
	27	M	C -V	7	59	M	C -V	6
	28	M	C -V	5	60	M	C -V	23
	29	F	NC-V	6	61	F	NC-V	3
	30	F	NC-V	2	62	F	NC-V	11
	31	F	C -V	2	63	F	C -V	4
	32	F	C -V	4	64	F	C -V	3

* NC = Noncongruent, C = Congruent, N = Noun, V = Verb

Table 4

Raw Data Experiment II
List I Unpaced Recall and Relearning

High-Recodable				Low- Recodable			
S#	SEX	LIST[a]	DATA[b]	S#	SEX	LIST[a]	DATA[b]
1	M	NC-V	9 (4)	33	M	NC-N	4 (6)
2	M	NC-V	6 (2)	34	M	NC-N	5 (1)
3	M	C -V	11 (5)	35	M	C -N	3 (3)
4	M	C -V	12 (5)	36	M	C -N	5 (4)
5	F	NC-V	8 (2)	37	F	NC-N	5 (5)
6	F	NC-V	4 (5)	38	F	NC-N	2 (5)
7	F	C -V	5 (5)	39	F	C -N	6 (5)
8	F	C -V	7 (1)	40	F	C -N	3 (4)
9	M	NC-N	4 (4)	41	M	NC-V	9 (1)
10	M	NC-N	4 (1)	42	M	NC-V	11 (2)
11	M	C -N	1 (8)	43	M	C -V	10 (6)
12	M	C -N	4 (3)	44	M	C -V	5 (4)
13	F	NC-N	5 (2)	45	F	NC-V	6 (2)
14	F	NC-N	3 (7)	46	F	NC-V	5 (7)
15	F	C -N	4 (6)	47	F	C -V	6 (4)
16	F	C -N	3 (4)	48	F	C -V	4 (1)
17	M	C -V	2 (3)	49	M	C -N	1 (8)
18	M	C -V	1 (8)	50	M	C -N	1 (8)
19	M	NC-V	6 (4)	51	M	NC-N	3 (6)
20	M	NC-V	3 (5)	52	M	NC-N	6 (5)
21	F	C -V	1 (8)	53	F	C -N	2 (5)
22	F	C -V	2 (7)	54	F	C -N	2 (6)
23	F	NC-V	4 (7)	55	F	NC-N	11 (6)
24	F	NC-V	1 (8)	56	F	NC-N	3 (6)
25	M	C -N	1 (8)	57	M	C -V	2 (7)
26	M	C -N	2 (7)	58	M	C -V	8 (6)
27	M	NC-N	5 (1)	59	M	NC-V	3 (6)
28	M	NC-N	1 (8)	60	M	NC-V	1 (8)
29	F	C -N	2 (7)	61	F	C -V	3 (7)
30	F	C -N	3 (7)	62	F	C -V	5 (6)
31	F	NC-N	2 (6)	63	F	NC-V	1 (8)
32	F	NC-N	1 (8)	64	F	NC-V	1 (8)

a NC = Noncongruent, C = Congruent, N = Noun, V = Verb

b Unpaced Recall data in parentheses

Table 5

Raw Data Experiment III
Trials to Criteria List I

	High-Recodable				Low-Recodable			
	S#	Sex	List*	Data	S#	Sex	List	Data
A-Br Conditions	1	M	HQ-AQ	6	33	M	AQ-AQ	9
	2	M	HQ-AQ	8	34	M	AQ-AQ	8
	3	M	HS-AS	6	35	M	AS-AS	6
	4	M	HS-AS	5	36	M	AS-AS	9
	5	M	AQ-HQ	3	37	M	HQ-HQ	5
	6	M	AQ-HQ	3	38	M	HQ-HQ	6
	7	M	AS-HS	13	39	M	HS-HS	10
	8	M	AS-HS	2	40	M	HS-HS	4
	9	F	HQ-AQ	2	41	F	AQ-AQ	3
	10	F	HQ-AQ	4	42	F	AQ-AQ	3
	11	F	HS-AS	6	43	F	AS-AS	5
	12	F	HS-AS	21	44	F	AS-AS	6
	13	F	AQ-HQ	14	45	F	HQ-HQ	10
	14	F	AQ-HQ	3	46	F	HQ-HQ	4
	15	F	AS-HS	5	47	F	HS-HS	3
	16	F	AS-HS	2	48	F	HS-HS	3
C-B Conditions	17	M	HS-AQ	3	49	M	AS-AQ	7
	18	M	HS-AQ	3	50	M	AS-AQ	5
	19	M	HQ-AS	6	51	M	AQ-AS	5
	20	M	HQ-AS	9	52	M	AQ-AS	14
	21	M	AS-HQ	8	53	M	HS-HQ	9
	22	M	AS-HQ	11	54	M	HS-HQ	3
	23	M	AQ-HS	4	55	M	HQ-HS	4
	24	M	AQ-HS	3	56	M	HQ-HS	5
	25	F	HS-AQ	5	57	F	AS-AQ	3
	26	F	HS-AQ	9	58	F	AS-AQ	9
	27	F	HQ-AS	8	59	F	AQ-AS	2
	28	F	HQ-AS	11	60	F	AQ-AS	1
	29	F	AS-HQ	7	61	F	HS-HQ	8
	30	F	AS-HQ	4	62	F	HS-HQ	2
	31	F	AQ-HS	6	63	F	HQ-HS	6
	32	F	AQ-HS	4	64	F	HQ-HS	2

* List I is given first followed by the transfer list. Conditions are indicated as Encoding Category (Animals-A and Household Furnishings-H) and Stimulus Sets (Q and S).

Table 6

Raw Data Experiment III
Trials to Criteria List II

	High-Recodable				Low-Recodable			
	S#	Sex	List*	Data	S#	Sex	List	Data
A-Br Conditions	1	M	HQ-AQ	6	33	M	AQ-AQ	9
	2	M	HQ-AQ	6	34	M	AQ-AQ	9
	3	M	HS-AS	4	35	M	AS-AS	7
	4	M	HS-AS	2	36	M	AS-AS	11
	5	M	AQ-HQ	7	37	M	HQ-HQ	9
	6	M	AQ-HQ	8	38	M	HQ-HQ	3
	7	M	AS-HS	12	39	M	HS-HS	8
	8	M	AS-HS	3	40	M	HS-HS	7
	9	F	HQ-AQ	3	41	F	AQ-AQ	5
	10	F	HQ-AQ	16	42	F	AQ-AQ	9
	11	F	HS-AS	6	43	F	AS-AS	6
	12	F	HS-AS	10	44	F	AS-AS	5
	13	F	AQ-HQ	8	45	F	HQ-HQ	15
	14	F	AQ-HQ	8	46	F	HQ-HQ	18
	15	F	AS-HS	3	47	F	HS-HS	12
	16	F	AS-HS	3	48	F	HS-HS	7
C-B Conditions	17	M	HS-AQ	1	49	M	AS-AQ	8
	18	M	HS-AQ	3	50	M	AS-AQ	1
	19	M	HQ-AS	3	51	M	AQ-AS	3
	20	M	HQ-AS	7	52	M	AQ-AS	5
	21	M	AS-HQ	7	53	M	HS-HQ	5
	22	M	AS-HQ	15	54	M	HS-HQ	2
	23	M	AQ-HS	2	55	M	HQ-HS	4
	24	M	AQ-HS	5	56	M	HQ-HS	4
	25	F	HS-AQ	2	57	F	AS-AQ	2
	26	F	HS-AQ	2	58	F	AS-AQ	2
	27	F	HQ-AS	2	59	F	AQ-AS	2
	28	F	HQ-AS	10	60	F	AQ-AS	3
	29	F	AS-HQ	4	61	F	HS-HQ	7
	30	F	AS-HQ	4	62	F	HS-HQ	4
	31	F	AQ-HS	5	63	F	HQ-HS	3
	32	F	AQ-HS	3	64	F	HQ-HS	3

* List I is given first followed by the transfer list. Conditions are indicated as Encoding Category (Animals-A and Household Furnishings-H) and Stimulus Sets (Q and S).

Table 7

Raw Data Experiment III
Unpaced Recall of List I

	High-Recodable				Low-Recodable			
	S#	Sex	List*	Data	S#	Sex	List	Data
A-Br Conditions	1	M	HQ-AQ	6	33	M	AQ-AQ	1
	2	M	HQ-AQ	3	34	M	AQ-AQ	3
	3	M	HS-AS	2	35	M	AS-AS	3
	4	M	HS-AS	2	36	M	AS-AS	2
	5	M	AQ-HQ	2	37	M	HQ-HQ	0
	6	M	AQ-HQ	5	38	M	HQ-HQ	2
	7	M	AS-HS	6	39	M	HS-HS	1
	8	M	AS-HS	3	40	M	HS-HS	6
	9	F	HQ-AQ	6	41	F	AQ-AQ	2
	10	F	HQ-AQ	3	42	F	AQ-AQ	2
	11	F	HS-AS	4	43	F	AS-AS	3
	12	F	HS-AS	6	44	F	AS-AS	4
	13	F	AQ-HQ	4	45	F	HQ-HQ	2
	14	F	AQ-HQ	2	46	F	HQ-HQ	4
	15	F	AS-HS	2	47	F	HS-HS	5
	16	F	AS-HS	4	48	F	HS-HS	3
C-B Conditions	17	M	HS-AQ	6	49	M	AS-AQ	6
	18	M	HS-AQ	4	50	M	AS-AQ	4
	19	M	HQ-AS	4	51	M	AQ-AS	5
	20	M	HQ-AS	3	52	M	AQ-AS	4
	21	M	AS-HQ	4	53	M	HS-HQ	2
	22	M	AS-HQ	4	54	M	HS-HQ	6
	23	M	AQ-HS	4	55	M	HQ-HS	6
	24	M	AQ-HS	3	56	M	HQ-HS	5
	25	F	HS-AQ	6	57	F	AS-AQ	3
	26	F	HS-AQ	5	58	F	AS-AQ	6
	27	F	HQ-AS	6	59	F	AQ-AS	6
	28	F	HQ-AS	5	60	F	AQ-AS	5
	29	F	AS-HQ	4	61	F	HS-HQ	3
	30	F	AS-HQ	3	62	F	HS-HQ	4
	31	F	AQ-HS	5	63	F	HQ-HS	3
	32	F	AQ-HS	4	64	F	HQ-HS	6

* List I is given first followed by the transfer list. Conditions are indicated as Encoding Category (Animals-A and Household Furnishings-H) and Stimulus Sets (Q and S).

Table 8

Raw Data Experiment III
Trials to Relearn List I

	High-Recodable				Low-Recodable			
	S#	Sex	List*	Data	S#	Sex	List	Data
A-Br Conditions	1	M	HQ-AQ	1	33	M	AQ-AQ	5
	2	M	HQ-AQ	3	34	M	AQ-AQ	4
	3	M	HS-AS	3	35	M	AS-AS	5
	4	M	HS-AS	2	36	M	AS-AS	7
	5	M	AQ-HQ	2	37	M	HQ-HQ	7
	6	M	AQ-HQ	4	38	M	HQ-HQ	4
	7	M	AS-HS	1	39	M	HS-HS	5
	8	M	AS-HS	4	40	M	HS-HS	1
	9	F	HQ-AQ	1	41	F	AQ-AQ	3
	10	F	HQ-AQ	5	42	F	AQ-AQ	8
	11	F	HS-AS	5	43	F	AS-AS	5
	12	F	HS-AS	1	44	F	AS-AS	3
	13	F	AQ-HQ	3	45	F	HQ-HQ	5
	14	F	AQ-HQ	6	46	F	HQ-HQ	6
	15	F	AS-HS	4	47	F	HS-HS	3
	16	F	AS-HS	2	48	F	HS-HS	3
C-B Conditions	17	M	HS-AQ	1	49	M	AS-AQ	1
	18	M	HS-AQ	2	50	M	AS-AQ	2
	19	M	HQ-AS	2	51	M	AQ-AS	2
	20	M	HQ-AS	4	52	M	AQ-AS	2
	21	M	AS-HQ	4	53	M	HS-HQ	2
	22	M	AS-HQ	4	54	M	HS-HQ	1
	23	M	AQ-HS	2	55	M	HQ-HS	1
	24	M	AQ-HS	6	56	M	HQ-HS	3
	25	F	HS-AQ	1	57	F	AS-AQ	2
	26	F	HS-AQ	2	58	F	AS-AQ	1
	27	F	HQ-AS	1	59	F	AQ-AS	1
	28	F	HQ-AS	3	60	F	AQ-AS	2
	29	F	AS-HQ	2	61	F	HS-HQ	2
	30	F	AS-HQ	2	62	F	HS-HQ	3
	31	F	AQ-HS	2	63	F	HQ-HS	3
	32	F	AQ-HS	3	64	F	HQ-HS	1

* List I is given first followed by the transfer list. Conditions are indicated as Encoding Category (Animals-A and Household Furnishings-H) and Stimulus Sets (Q and S).

Appendix D

Complete Analyses of Variance

Table 1

Complete ANOVA Experiment I
List I

Source	df	Mean Square	F	p
A (Recodability)	1	16.00	0.27	-
B (Sex)	1	33.06	0.56	-
AB	1	10.56	0.18	-
C (Part of Speech)	1	121.00	2.05	-
AC	1	0.25	0.00	-
BC	1	68.06	1.16	-
ABC	1	68.06	1.16	-
D (Stimulus Set)	1	1.00	0.02	-
AD	1	81.00	1.38	-
BD	1	10.56	0.18	-
ABD	1	85.56	1.45	-
CD	1	1.00	0.02	-
ACD	1	6.25	0.11	-
BCD	1	10.56	0.18	-
ABCD	1	0.06	0.00	-
ERROR	16	58.87	-	-
J (Stimulus Items)	1	81.00	11.07	.01
AJ	1	6.25	0.85	-
BJ	1	7.56	1.03	-
ABJ	1	14.06	1.92	-
CJ	1	6.25	0.85	-
ACJ	1	6.25	0.85	-
BCJ	1	00.56	0.08	-
ABCJ	1	1.56	0.21	-
DJ	1	30.25	4.14	.10
ADJ	1	0.00	0.00	-
BDJ	1	3.06	0.42	-
ABDJ	1	14.06	1.92	-
CDJ	1	16.00	2.18	-
ACDJ	1	1.00	0.14	-
BCDJ	1	3.06	0.42	-
ABCDJ	1	18.06	2.47	-
ERROR	16	7.31	-	-

Table 2

Complete ANOVA Experiment I
List II

Source	df	Mean Square	F	p
A(Recodability)	1	10.56	0.05	-
B(Sex)	1	68.06	0.29	-
AB	1	289.00	1.27	-
C(Part of Speech)	1	663.06	2.91	.10
AC	1	0.25	0.00	-
BC	1	9.00	0.04	-
ABC	1	637.56	2.79	-
D(Stimulus Set)	1	20.25	0.09	-
AD	1	162.56	0.71	-
BD	1	45.56	0.20	-
ABD	1	400.00	1.75	-
CD	1	68.06	0.29	-
ACD	1	56.25	0.24	-
BCD	1	132.25	0.56	-
ABCD	1	410.06	1.80	-
ERROR	16	228.16	-	-
J(Stimulus Items)	1	1785.06	104.43	-
AJ	1	6.25	0.36	-
BJ	1	20.25	1.18	-
ABJ	1	0.06	0.00	-
CJ	1	20.25	1.18	-
ACJ	1	33.06	1.93	.10
BCJ	1	3.06	0.18	-
ABCJ	1	81.00	4.74	.05
DJ	1	95.06	5.56	.05
ADJ	1	30.25	1.77	-
BDJ	1	25.00	1.46	-
ABDJ	1	162.56	9.51	.01
CDJ	1	81.00	4.74	.05
ACDJ	1	68.06	3.98	.10
BCDJ	1	0.56	0.03	-
ABCDJ	1	9.00	0.56	-
ERROR	16	17.09	-	-

Table 3

Complete ANOVA Experiment II
Trials to Criterion List I

Source	df	Mean Square	F	p
A (Recodability)	1	85.56	2.56	-
B (Paradigm)	1	27.56	0.82	-
C (Part of Speech)	1	289.00	8.65	.01
D (Sex)	1	14.06	0.42	-
E (Stimulus Set)	1	132.25	3.96	.1[illegible]
AB	1	22.56	0.67	-
AC	1	49.00	1.47	-
BC	1	9.00	0.27	-
AD	1	27.56	0.82	-
BD	1	.06	0.00	-
CD	1	4.00	0.12	-
AE	1	25.00	0.75	-
BE	1	36.00	1.08	-
CE	1	150.06	4.49	.05
DE	1	12.25	0.37	-
ABC	1	2.25	0.07	-
ABD	1	27.56	0.82	-
ACD	1	49.00	1.47	-
BCD	1	00.00	0.00	-
ABE	1	9.00	0.27	-
ACE	1	0.56	0.02	-
BCE	1	150.06	4.49	.05
ADE	1	16.00	0.48	-
BDE	1	25.00	0.75	-
CDE	1	14.06	0.42	-
ABCD	1	20.25	0.61	-
ABCE	1	27.56	0.83	-
ABDE	1	64.00	1.92	-
ACDE	1	22.56	0.67	-
BCDE	1	105.06	3.14	.10
ABCDE	1	248.00	7.42	.025
ERROR	32	33.41		

Table 4

Complete ANOVA Experiment II
Trials to Criterion List II

Source	df	Mean Square	F	p
A (Recodability)	1	54.39	2.97	.1
B (Paradigm)	1	395.02	21.37	.005
C (Part of Speech)	1	0.14	0.01	-
D (Sex)	1	78.76	4.26	.05
E (Stimulus Set)	1	5.64	0.30	-
AB	1	15.01	0.81	-
AC	1	221.26	11.97	.005
BC	1	1.26	0.07	-
AD	1	0.14	0.01	-
BD	1	1.26	0.07	-
CD	1	2.64	0.14	-
AE	1	54.39	2.94	.10
BE	1	118.26	6.40	.025
CE	1	23.76	1.28	-
DE	1	50.76	2.75	-
ABC	1	23.76	1.29	-
ABD	1	0.76	0.04	-
ACD	1	62.02	3.36	.10
BCD	1	17.02	0.92	-
ABE	1	87.89	4.75	.05
ACE	1	9.76	0.52	-
BCE	1	8.26	0.45	-
ADE	1	3.51	0.19	-
BDE	1	2.64	0.14	-
CDE	1	31.64	1.71	-
ABCD	1	0.76	0.04	-
ABCE	1	0.39	0.02	-
ABDE	1	23.76	1.28	-
ACDE	1	43.89	2.37	-
BCDE	1	19.14	1.03	-
ABCDE	1	0.01	0.00	-
ERROR	32	18.49		

Table 5

Complete ANOVA Experiment II
List I Relearning Trials to Criterion

Source	df	Mean Square	F	p
A (Recodability)	1	3.51	0.87	-
B (Paradigm)	1	123.76	30.82	.005
C (Part of Speech)	1	47.26	11.77	.005
D (Sex)	1	13.14	3.27	.10
E (Stimulus Set)	1	3.51	0.87	-
AB	1	4.52	1.12	-
AC	1	5.64	1.40	-
BC	1	54.39	13.54	.005
AD	1	0.39	0.10	-
BD	1	9.76	2.43	-
CD	1	28.89	7.17	.025
AE	1	0.39	0.10	-
BE	1	2.64	0.66	-
CE	1	11.39	2.84	-
DE	1	0.76	0.19	-
ABC	1	0.14	0.04	-
ABD	1	1.89	0.47	-
ACD	1	0.39	0.01	-
BCD	1	3.50	0.87	-
ABE	1	2.64	0.66	-
ACE	1	4.52	1.12	-
BCE	1	4.52	1.12	-
ADE	1	.02	0.00	-
BDE	1	0.39	0.10	-
CDE	1	0.76	0.19	-
ABCD	1	1.19	0.47	-
ABCE	1	47.26	11.77	.005
ABDE	1	9.76	2.43	-
ACDE	1	3.52	0.87	-
BCDE	1	1.89	0.47	-
ABCDE	1	0.76	0.19	-
ERROR	32	4.01	-	-

Table 6

Complete ANOVA Experiment II
List I Unpaced Recall

Source	df	Mean Square	F	p
A (Recodability)	1	0.00	0.00	-
B (Paradigm)	1	110.25	28.45	.005
C (Part of Speech)	1	1.00	0.26	-
D (Sex)	1	5.06	1.31	-
E (Stimulus Set)	1	6.25	1.61	-
AB	1	1.00	0.26	-
AC	1	1.00	0.26	-
BC	1	4.00	1.03	-
AD	1	1.56	0.40	-
BD	1	0.56	0.14	-
CD	1	0.06	0.02	-
AE	1	4.00	1.03	-
BE	1	0.25	0.06	-
CE	1	2.25	0.58	-
DE	1	22.56	5.82	.025
ABC	1	1.00	0.26	-
ABD	1	7.56	1.95	-
ACD	1	0.06	0.02	-
BCD	1	7.56	1.95	-
ABE	1	0.00	0.00	-
ACE	1	0.25	0.06	-
BCE	1	2.25	0.58	-
ADE	1	0.06	0.02	-
BDE	1	0.56	0.14	-
CDE	1	0.06	0.02	-
ABCD	1	0.06	0.02	-
ABCE	1	2.25	0.58	-
ABDE	1	0.06	0.02	-
ACDE	1	1.56	0.40	-
BCDE	1	5.06	1.30	-
ABCDE	1	1.56	0.40	-
ERROR	32	3.87	-	-

Table 7

Complete ANOVA Experiment III
Trials to Criterion List I

Source	df	Mean Square	F	p
A (Recodability)	1	9.77	0.75	-
B (Paradigm)	1	1.89	0.14	-
C (Sex)	1	6.89	0.53	-
D (Encoding Cat.)	1	1.26	0.10	-
E (Stimulus Set)	1	6.89	0.53	-
AB	1	0.76	0.06	-
AC	1	50.76	3.88	.10
BC	1	0.14	0.01	-
AD	1	15.02	1.15	-
BD	1	1.26	0.10	-
CD	1	31.64	2.42	-
AE	1	1.89	0.14	-
BE	1	1.26	0.10	-
CE	1	1.26	0.10	-
DE	1	2.64	0.20	-
ABC	1	0.39	0.03	-
ABD	1	0.14	0.01	-
ACD	1	0.02	0.00	-
BCD	1	3.51	0.27	-
ABE	1	11.39	0.87	-
ACE	1	2.64	0.20	-
BCE	1	0.77	0.06	-
ADE	1	0.14	0.01	-
BDE	1	19.14	1.46	-
CDE	1	8.26	0.63	-
ABCD	1	1.26	0.10	-
ABCE	1	15.01	1.14	-
ABDE	1	50.76	3.88	.10
ACDE	1	135.14	10.33	.01
BCDE	1	11.39	0.87	-
ABCDE	1	13.14	1.00	-
ERROR	32	13.08		

Table 8

Complete ANOVA Experiment III
Trials to Criterion List II

Source	df	Mean Square	F	p
A(Recodability)	1	4.516	0.47	-
B(Paradigm)	1	199.516	20.97	.01
C(Sex)	1	0.39	0.04	-
D(Encoding Cat.)	1	21.39	2.25	-
E(Stimulus Set)	1	23.76	2.50	-
AB	1	43.89	4.61	.05
AC	1	1.26	0.13	-
BC	1	26.26	2.76	-
AD	1	1.26	0.13	-
BD	1	0.14	0.01	-
CD	1	0.39	0.04	-
AE	1	0.02	0.00	-
BE	1	11.39	1.20	-
CE	1	3.52	0.37	-
DE	1	28.89	3.04	.10
ABC	1	0.02	0.00	-
ABD	1	13.14	1.38	-
ACD	1	112.89	11.86	.005
BCD	1	4.52	0.47	-
ABE	1	1.26	0.13	-
ACE	1	19.14	2.01	-
BCE	1	23.76	2.50	-
ADE	1	4.52	0.47	-
BDE	1	9.76	1.03	-
CDE	1	8.26	0.87	-
ABCD	1	21.39	2.25	-
ABCE	1	1.26	0.13	-
ABDE	1	15.02	1.58	-
ACDE	1	8.26	0.87	-
BCDE	1	15.02	1.58	-
ABCDE	1	6.89	0.72	-
ERROR	32	9.52	-	-

Table 9

Complete ANOVA Experiment III
List I Relearning Trials to Criterion

Source	df	Mean Square	F	p
A (Recodability)	1	3.52	1.38	-
B (Paradigm)	1	40.64	15.96	.001
C (Sex)	1	0.14	0.06	-
D (Encoding Cat.)	1	4.51	1.77	-
E (Stimulus Set)	1	5.64	2.21	-
AB	1	23.76	9.33	.01
AC	1	0.02	0.01	-
BC	1	2.64	1.04	-
AD	1	1.89	0.74	-
BD	1	0.39	0.15	-
CD	1	1.27	0.50	-
AE	1	0.14	0.06	-
BE	1	0.76	0.30	-
CE	1	0.39	0.15	-
DE	1	0.76	0.30	-
ABC	1	5.64	2.21	-
ABD	1	2.64	1.04	-
ACD	1	0.02	0.01	-
BCD	1	0.76	0.30	-
ABE	1	1.89	0.74	-
ACE	1	0.02	0.01	-
BCE	1	2.64	1.04	-
ADE	1	1.89	0.74	-
BDE	1	0.14	0.06	-
CDE	1	1.89	0.74	-
ABCD	1	0.39	0.15	-
ABCE	1	0.39	0.15	-
ABDE	1	5.64	2.21	-
ACDE	1	0.14	0.05	-
BCDE	1	0.14	0.05	-
ABCDE	1	0.76	0.30	-
ERROR	32	2.55	-	-

Table 10

Complete ANOVA Experiment III
List I Unpaced Recall

Source	df	Mean Square	F	p
A (Recodability)	1	2.64	1.18	-
B (Paradigm)	1	26.26	11.75	.005
C (Sex)	1	2.64	1.18	-
D (Encoding Cat.)	1	1.89	0.85	-
E (Stimulus Set)	1	0.39	0.17	-
AB	1	6.89	3.08	.10
AC	1	0.14	0.06	-
BC	1	0.39	0.17	-
AD	1	2.64	1.18	-
BD	1	0.14	0.06	-
CD	1	2.64	1.18	-
AE	1	0.39	0.17	-
BE	1	2.64	1.18	-
CE	1	0.39	0.17	-
DE	1	0.14	0.06	-
ABC	1	2.64	1.18	-
ABD	1	1.89	0.85	-
ACD	1	3.52	1.57	-
BCD	1	2.64	1.18	-
ABE	1	6.89	3.08	.10
ACE	1	0.02	0.01	-
BCE	1	1.89	0.85	-
ADE	1	0.02	0.01	-
BDE	1	0.14	0.06	-
CDE	1	0.76	0.34	-
ABCD	1	0.02	0.01	-
ABCE	1	1.26	0.57	-
ABDE	1	4.52	2.02	-
ACDE	1	1.26	0.57	-
BCDE	1	0.02	0.01	-
ABCDE	1	4.52	2.02	-
ERROR	32	2.23	-	-